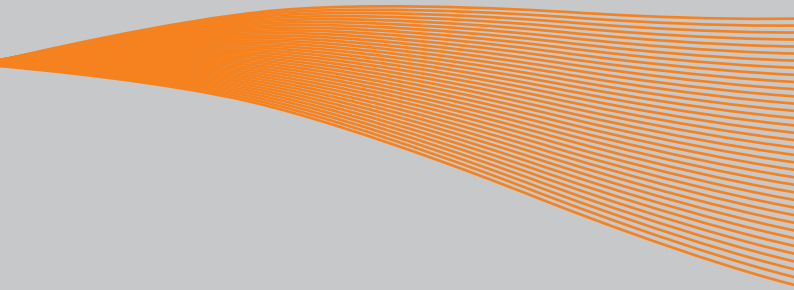
VACON 10
AC DRIVES

VACON 10 PFC USER MANUAL



VACON
DRIVEN BY DRIVES

1.SAFETY

ONLY A COMPETENT ELECTRICIAN IS ALLOWED TO CARRY OUT THE ELECTRICAL INSTALLATION.

This manual contains clearly marked cautions and warnings which are intended for your personal safety and to avoid any unintentional damage to the product or connected appliances.

Please read the following safety information carefully:

	**= Dangerous voltage** Risk of death or severe injury
	**= General warning** Risk of damage to the product or connected appliances

1.1 Warnings


The components of the power unit of the frequency converter are live when Vacon 10 is connected to the mains. Coming into contact with this voltage is extremely dangerous and may cause death or severe injury. The control unit is isolated from the mains.


The motor terminals U, V, W (T1, T2, T3) and the possible brake resistor terminals -/+ are live when Vacon 10 is connected to the mains, even if the motor is not running.


The control unit I/O-terminals are isolated from the mains. However, the relay output terminals may have a dangerous control voltage present even when Vacon 10 is disconnected from the mains.


Ground leakage current of Vacon 10 frequency converters exceeds 3.5mA AC. According to standard EN61800-5-1, a reinforced protective ground connection must be ensured.


If the frequency converter is used as a part of a machine, the machine manufacturer is responsible for providing the machine with a main switch (EN 60204-1).


If Vacon 10 is disconnected from the mains while running the motor, it remains live if the motor is energized by the process. In this case the motor functions as a generator feeding energy to the frequency converter.


After disconnecting the frequency converter from the mains, wait until the fan stops and the indicators on the display disappear. Wait 5 more minutes before doing any work on Vacon 10 connections.


The motor can start automatically after a fault if the automatic restart function has been enabled.

1.2 Safety instructions

The Vacon 10 frequency converter is intended for fixed installations only.

Do not perform any measurements when the frequency converter is connected to the mains.

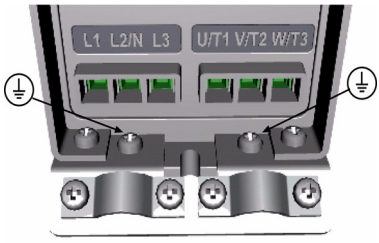
Do not perform any insulation tests on any part of Vacon 10. Product safety has undergone full factory testing.

Prior to measuring the motor or the motor cable, disconnect the motor cable from the frequency converter.

Do not open the cover of Vacon 10. Static voltage discharge from your fingers may damage the components. Opening the cover may also damage the device. If the cover of Vacon 10 is opened, warranty becomes void.

1.3 Grounding and ground fault protection

The Vacon 10 frequency converter **must always** be grounded with a ground conductor connected to the grounding terminal. See figure below:



- The ground fault protection inside the frequency converter protects only the converter itself against ground faults.
- If ground fault current protective switches are used, they must be tested on the drive with ground fault currents that may arise in fault situations.

1.4 Before running the motor

Checklist:

Before running the motor, check it is correctly installed and make sure that the machine it is connected to allows the motor to be started.

Set the maximum motor speed (frequency) according to the motor and the machine connected to it.

Before reversing the motor shaft rotation direction make sure that this can be done safely.

Make sure that no power correction capacitors are connected to the motor cable.

2. RECEIPT OF DELIVERY

After unpacking the product, check there are no signs of transport damages to the product and that the delivery is complete (compare the type designation of the product to the code below).

If the drive is damaged during shipping, please contact the shipper's insurance company or the carrier.

If the delivery does not correspond to your order, contact the supplier immediately.

2.1 Type designation code

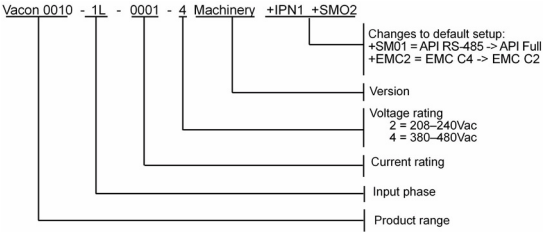


Figure 2.1: Vacon 10 type designation code

2.2 Storage

If the frequency converter is to be kept in store before use make sure that ambient conditions are acceptable:

Storage temperature-40...+70°C

Relative humidity < 95%, no condensation

2.3 Maintenance

In normal operating conditions, Vacon 10 frequency converters are maintenance-free.

2.4 Warranty

Only manufacturing defects are covered by the warranty. The manufacturer assumes no responsibility for damages caused during or resulting from transport, receipt of the delivery, installation, commissioning or use.

The manufacturer shall in no event and under no circumstances be held responsible for damages and failures resulting from misuse, wrong installation, unacceptable ambient temperature, dust, corrosive substances or operation outside the rated specifications. Neither can the manufacturer be held responsible for consequential damages.

The Manufacturer's time of warranty is 18 months from the delivery or 12 months from commissioning, whichever expires first (General Conditions NL92/Orgalime S92).

The local distributor may grant a warranty time different from the above. This warranty time shall be specified in the distributor's sales and warranty terms. Vacon assumes no responsibility for any other warranties than that granted by Vacon itself.

In all matters concerning the warranty, please contact your distributor.

3. INSTALLATION

3.1 Mechanical installation

There are two ways of mounting Vacon 10 on the wall: screw mounting or DIN-rail mounting. Mounting dimensions are listed on the back of the unit and on the following page.

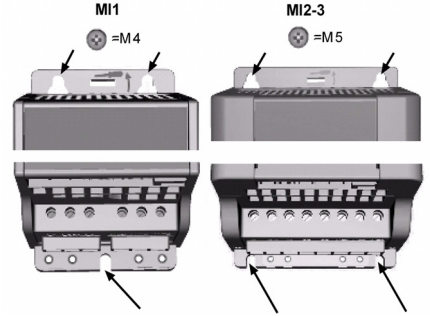


Figure 3.2: Screw mounting

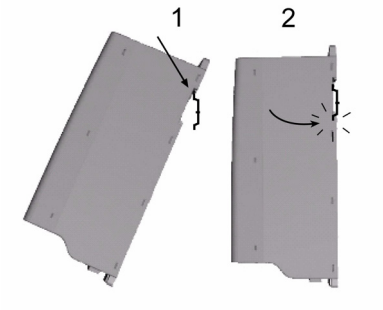


Figure 3.3: DIN-rail mounting

3.1.1 Vacon 10 dimensions

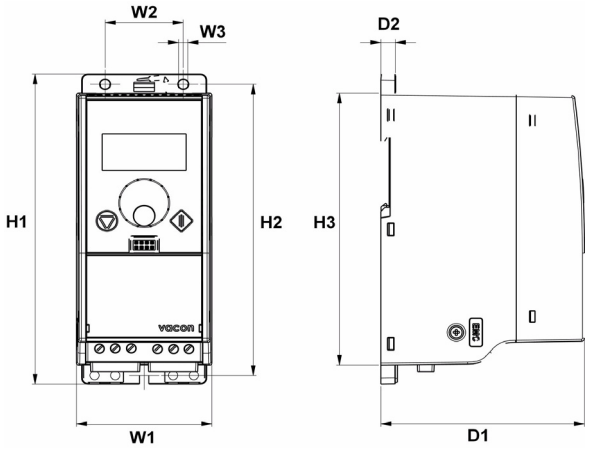


Figure 3.4: Vacon 10 dimensions, MI1-MI3

Type	H1	H2	H3	W1	W2	W3	D1	D2
MI1	156,5	147	137,3	65,5	37,8	4,5	98,5	7
MI2	195	183	170	90	62,5	5,5	101,5	7
MI3	262,5	252,3	241,3	100	75	5,5	108,5	7

Table 3.1: Vacon 10 dimensions in millimetres

3.1.2 Cooling

All Vacon 10 drives use forced air flow cooling
Enough free space shall be left above and below the frequency converter to ensure sufficient air circulation and cooling. You will find the required dimensions for free space in the table below:

Type	Dimensions (mm)	
	A	B
MI1	100	50
MI2	100	50
MI3	100	50

Table 3.2: Dimensions required for cooling

Type	Cooling air required (m^3/h)
MI1	10
MI2	10
MI3	30

Table 3.3: Cooling air required

3.1.3 EMC levels

Category C1 (Vacon EMC class C): Frequency converters of this class comply with the requirements of category C1 of the product standard EN 61800-3 (2004). Category C1 ensures the best EMC characteristics and it includes converters the rated voltage of which is less than 1000V and which are intended for use in the 1st environment. NOTE: The requirements of class C are fulfilled only as far as the conducted emissions are concerned.

Category C2 (Vacon EMC class H): Frequency converters of this class comply with the requirements of category C2 of the product standard EN 61800-3 (2004). Category C2 includes converters in fixed installations the rated voltage of which is less than 1000 V. Class H frequency converters can be used in both the 1st and 2nd environment.

Category C3 (Vacon EMC class L): Frequency converters of this class comply with the requirements of category C3 of the product standard EN 61800-3 (2004). Category C3 includes converters the rated voltage of which is less than 1000V and which are intended for use in the second environment only.

Category C4 (Vacon EMC class N): The drives of this class do not provide EMC emission protection. These kinds of drives are mounted in enclosures. NOTE: An external EMC filter is usually required to fulfil the EMC emission requirements.

Category C4 for IT networks (Vacon EMC class T): Frequency converters of this class fulfil the product standard EN 61800-3 (2004) if intended to be used in IT systems. In IT systems, the networks are isolated from ground, or connected to ground through high impedance to achieve a low leakage current. NOTE: if converters are used with other supplies, no EMC requirements are complied with.

Environments in product standard EN 61800-3 (2004)

First environment: Environment that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes.

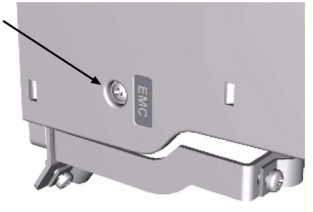
NOTE: houses, apartments, commercial premises or offices in a residential building are examples of first environment locations.

Second environment: Environment that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.
NOTE: industrial areas, technical areas of any building fed from a dedicated transformer are examples of second environment locations.

3.1.4 Changing the EMC protection class from H or L to T

The EMC protection class of Vacon 10 frequency converters can be changed from H or L to T **by removing the EMC-capacitator disconnection screw**. See figure below. **Note:** Do not attempt to change the EMC level back to class H or L. Even if the procedure above is reversed, the frequency converter will no longer fulfil the EMC requirements of class H/L.

Vacon 10 frequency converters are divided into five classes according to the level of electromagnetic disturbances emitted, the requirements of a power system network and the installation environment (see below). The EMC class of each product is defined in the type designation code.



3.2 Cabling and connections

3.2.1 Power cabling

Note: Tightening torque for power cables is 0.5 - 0.6 Nm

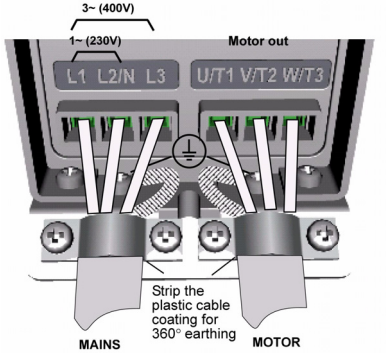


Figure 3.5: Vacon 10 power connections, MI1

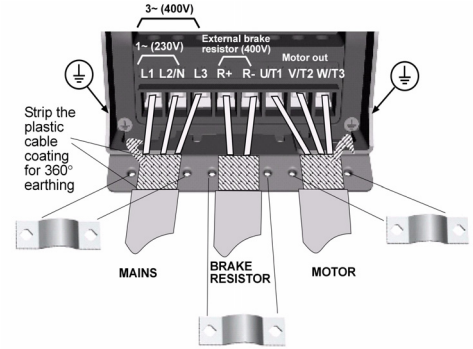


Figure 3.6: Vacon 10 power connections, MI2 - MI3

3.2.2 Control cabling

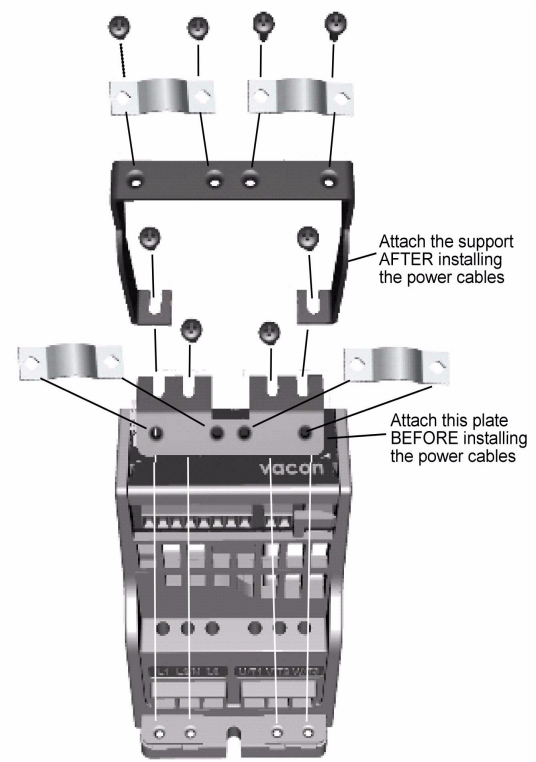


Figure 3.7: Mount the PE- plate and API cable support

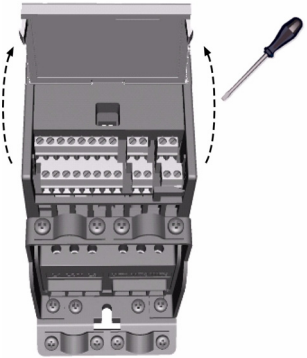


Figure 3.8: Open the cover

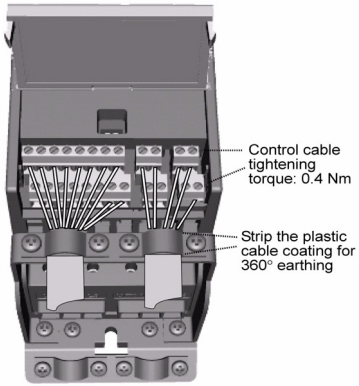


Figure 3.9: Install the control cables. See chapter 6.

3.2.3 Cable and fuse specifications

Use cables with at least +70 C heat resistance. Cables and fuses must be dimensioned according to the tables below. Installation of cables according to UL regulations is presented in Chapter 3.2.6.

The fuses also act as cable overload protection.
These instructions apply only to cases with one motor and one cable connection from the frequency converter to the motor. In any other case, ask the factory for more information.

EMC class	Level H	Level L	Level N
Mains cable types	1	1	1
Motor cable types	3	2	1
Control cable types	4	4	4

Table 3.4: Cable types required to meet standards. EMC levels are described in Chapter 3.1.3.

Cable type	Description
1	Power cable intended for fixed installation and the specific mains voltage. Shielded cable not required. (NKCABLES/MCMK or similar recommended)
2	Power cable equipped with concentric protection wire and intended for the specific mains voltage. (NKCABLES /MCMK or similar recommended).
3	Power cable equipped with compact low-impedance shield and intended for the specific mains voltage. (NKCABLES /MCCMK, SAB/ÖZCUY-J or similar recommended). *360º grounding of both motor and FC connection required to meet the standard
4	Screened cable equipped with compact low-impedance shield (NKCABLES / Jamak, SAB/ÖZCuY-O or similar).

Table 3.5: Cable type descriptions

Frame	Type	I_N [A]	Fuse[A]	Mains cable Cu [mm²]	Terminal cable size (min/max)			
					Main terminal [mm²]	Ground terminal [mm²]	Control terminal [mm²]	Relay terminal [mm²]
MI1	0001-0004	1,7-3,7	10	2*1,5+1,5	1,5-4	1,5-4	0,5-1,5	0,5-1,5
MI2	0005-0007	4,8-7,0	20	2*2,5+2,5	1,5-4	1,5-4	0,5-1,5	0,5-1,5
MI3	0009	6,9	32	2*6+6	1,5-6	1,5-6	0,5-1,5	0,5-1,5

Table 3.6: Cable and fuse sizes for Vacon 10, 208 - 240 V

Frame	Type	I_N [A]	Fuse[A]	Mains cable Cu [mm²]	Terminal cable size (min/max)			
					Main terminal [mm²]	Ground terminal [mm²]	Control terminal [mm²]	Relay terminal [mm²]
MI1	0001-0004	1,9-3,3	6	3*1,5+1,5	1,5-4	1,5-4	0,5-1,5	0,5-1,5
MI2	0005-0006	4,3-5,6	10	3*1,5+1,5	1,5-4	1,5-4	0,5-1,5	0,5-1,5
MI3	0008-0012	7,6 - 12	20	3*2,5+2,5	1,5-6	1,5-6	0,5-1,5	0,5-1,5

Table 3.7: Cable and fuse sizes for Vacon 10, 380 - 480V

3.2.4 General cabling rules

1

Before starting the installation, check that none of the components of the frequency converter is live.

2

Place the motor cables far enough from other cables:
- **Avoid** placing the motor cables in long **parallel lines** with other cables.
- If the motor cable runs in parallel with the other cables, the **minimum distance** between the motor cable and the other cables is **0.3 m**.
- The given distance also applies between the motor cables and signal cables of other systems.
- The **maximum length** of the motor cables is **30 m**
- The **motor cables** should cross other cables at an angle of **90 degrees**.

3

If cable insulation checks are needed, see Chapter 3.2.7.

4

Connecting the cables:
- Strip the motor and mains cables as advised in Figure 3.10.
- Connect the mains, motor and control cables into their respective terminals. (See figures 3.5 - 3.9).
- Note the tightening torques of **power cables and control cables** given in page 13and page 15.
- For information on cable installation according to UL regulations see Chapter 3.2.6 .
- Make sure that the control cable wires do not come in contact with the electronic components of the unit.
- If an **external brake resistor** (option) is used, connect its cable to the appropriate terminal.
- **Check the connection** of the ground cable to the motor and the frequency converter terminals marked with.
- Connect **the shield of the motor cable to the ground** of the frequency converter, motor and supply centre.

3.2.5 Stripping lengths of motor and power cables

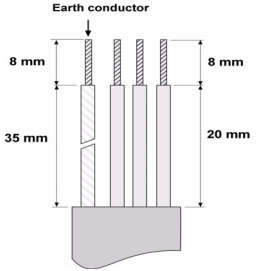


Figure 3.10: Stripping of cables

Note: Strip also the plastic cover of the cables for 360 degree grounding. See Figures 3.5, 3.6 and 3.9.

3.2.6 Cable installation and the UL standards

To meet the UL (Underwriters Laboratories) regulations, a UL-approved copper cable with a minimum heat-resistance of +60/75 C must be used.

3.2.7 Cable and motor insulation checks

These checks can be performed as follows if motor or cable insulations are suspected to be faulty.

1. Motor cable insulation checks

Disconnect the motor cable from terminals U/T1, V/T2 and W/T3 of the frequency converter and from the motor. Measure the insulation resistance of the motor cable between each phase conductor as well as between each phase conductor and the protective ground conductor.

The insulation resistance must be >1MOhm.

2. Mains cable insulation checks

Disconnect the mains cable from terminals L1, L2/N and L3 of the frequency converter and from the mains. Measure the insulation resistance of the mains cable between each phase conductor as well as between each phase conductor and the protective ground conductor. The insulation resistance must be >1MOhm.

3. Motor insulation checks

Disconnect the motor cable from the motor and open the bridging connections in the motor connection box . Measure the insulation resistance of each motor winding. The measurement voltage must equal at least the motor nominal voltage but not exceed 1000 V. The insulation resistance must be >1MOhm.

4. COMMISSIONING

Before commissioning, note the warnings and instructions listed in Chapter 1.

4.1 Commissioning steps of Vacon 10

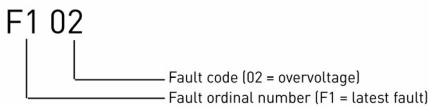
1	Read the safety instructions in Chapter 1 carefully and follow them.
2	After installation, make sure that: • both the frequency converter and the motor are grounded • the mains and motor cables comply with the requirements given in Chapter 3.2.3 • the control cables are located as far as possible from the power cables (see Chapter 3.2.4, step 2) and that the shields of the shield cables are connected to protective ground 
3	Check the quality and quantity of cooling air (Chapter 3.1.2)
4	Check that all Start/Stop switches connected to the I/O terminals are in **Stop**-position.
5	Connect the frequency converter to mains
Note: The following steps are valid if you have an API Full or API Limited Application Interface in your Vacon 10.	
6	Set the parameters of group 1 according to the requirements of your application. At least the following parameters should be set: • motor nominal voltage (par. 1.1) • motor nominal frequency (par. 1.2) • motor nominal speed (par. 1.3) • motor nominal current (par. 1.4) You will find the values needed for the parameters on the motor specification plate.
7	Perform test run **without motor**. Perform Test A: **A)** Control from the I/O terminals: • Activate digital inputs DI1 (8) and D13 (10). • Change the frequency reference (potentiometer) • Check in the Monitoring Menu that output frequency changes according to the change in frequency reference. • Turn the Start/Stop switch, DI1, to OFF position.

8	Run the no-load tests without the motor being connected to the process, if possible. If this is not possible, ensure the safety of each test prior to running it. Inform your co-workers of the tests. • Switch off the supply voltage and wait until the drive has stopped. • Connect the motor cable to the motor and to the motor cable terminals of the frequency converter. • Make sure that all Start/Stop switches are in Stop positions. • Switch the mains ON • Repeat test 7A.
9	Connect the motor to the process (if the no-load test was run without the motor being connected). • Before running the tests, make sure that this can be done safely. • Inform your co-workers of the tests. • Repeat test 7A.

5. FAULT TRACING

Note: The fault codes listed in this chapter are visible if the Application Interface has a display, like e.g. in API FULL or API LIMITED or if a personal computer has been connected to the drive.

When a fault is detected by the frequency converter control electronics, the drive is stopped and the symbol F together with the ordinal number of the fault and the fault code appear on the display in the following format, e.g:



The fault can be reset by pressing the stop button on the control keypad. The faults with time labels are stored in the Fault history menu which can be browsed. The different fault codes, their causes and correcting actions are presented in the table below.

Fault code	Fault name	Possible cause	Correcting actions
1	Overcurrent	Frequency converter has detected too high a current (>4*I_N) in the motor cable : • sudden heavy load increase • short circuit in motor cables • unsuitable motor	Check loading. Check motor size. Check cables.
2	Overvoltage	DC-link voltage has exceed the internal safety limit: • too short a deceleration time • high overvoltage spikes in mains	Increase the deceleration time (P.4.3)
3	Ground fault	Current measurement has detected extra leakage current at start: • insulation failure in cables or motor	Check motor cables and motor.
8	System fault	• component failure • faulty operation	Reset the fault and restart. If the fault recurs, contact the nearest distributor.

Table 5.1: Fault codes

Fault code	Fault name	Possible cause	Correcting actions
9	Undervoltage	DC-link voltage has exceeded the internal safety limit: • most probable cause: too low a supply voltage • frequency converter internal fault • Power outages	In case of temporary supply voltage break reset the fault and restart the frequency converter. Check the supply voltage. If it is adequate, an internal failure has occurred. Contact the nearest distributor.
13	Frequency converter low temperature	IGBT switch temperature is below -10ºC	Check ambient temperature.
14	Frequency converter overheating	IGBT switch temperature is above 120ºC. Overheating warning is issued when IGBT switch temperature exceeds 110ºC.	Check that the cooling air flow is not blocked. Check ambient temperature. Make sure that the switching frequency is not too high in relation to ambient temperature and motor load.
15	Motor stalled	Motor stall protection has been activated.	Check motor
16	Motor overheating	Motor overheating has been detected by frequency converter motor temperature model. Motor is overloaded.	Decrease the motor load. If no motor overload exists, check the temperature model parameters.
17	Underload	The motor is underloaded. Eg. lack of input water.	Check the load and parameters related to underload detection (P6.5-P6.8)
22	EEPROM fault	Parameter save fault • faulty operation • component failure	Contact the nearest distributor.
25	Microcontroller watchdog fault	• faulty operation • component failure	Reset the fault and restart. If the fault recurs, contact the nearest distributor.
34	Internal bus communication	Ambient interference or defective hardware	If the fault recurs, contact your nearest distributor.
35	System fault	System does not work	Contact the nearest distributor.
50	Analog input I_{in} < 4 mA (selected signal range 4 to 20 mA)	Current at the analog input is < 4mA • control cable is broken or loose • signal source has failed	Check the sensor and sensor cable.

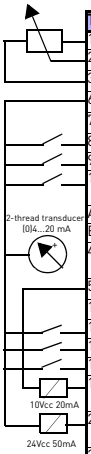
Table 5.1: Fault codes

Fault code	Fault name	Possible cause	Correcting actions
51	External fault	Digital input fault. Digital input has been programmed as an external fault input and this input is active.	Check the programming and the device indicated by the external fault information. Also the cabling of this device.
53	Fieldbus fault	The data connection between the fieldbus Master and the fieldbus of the drive has broken.	Check installation. If installation is correct contact the nearest Vacon distributor.
80	Interlock alarm	An autochange with interlocks (P1.7) has been selected and the controller fails to detect them.	Use the monitoring menu (M1.14) to check the state of digital inputs D14, D15 and D16 and also check their cabling.
81	System identification fault	Pressure unit discharge has not been closed properly.	Check that the pressure unit discharge opens and closes correctly.
82	Output frequency < Reference frequency	The pump is unable to rotate at system-desired speed due to high consumption or to the mains power supply being too low.	Check the controller power supply and that the pump is not blocked or the discharge piping dirty.

Table 5.1: Fault codes

6. PFC system interface

6.1 I/O Control



Terminal		Signal	Preset factory value	Description
1	+10Vre	Ref. voltage output		Maximum load 10 mA
2	AI1	Frequency Reference		0 - +10 V Ri = 200 kΩ (min)
3	GND	I/O signal ground		
6	24Vcc			±20 %, max. load 50 mA
7	GND	I/O signal ground		
8	DI1	Digital input 1	Run	0 - +30 V Ri = 12 kΩ min
9	DI2	Digital input 2	PI 2 Reference	
10	DI3	Digital input 3	Disable PI (Frequency ref. from AI1)	
A	A			
B	B			
4	AI2	Analog signal	Pressure input 4-20mA	0(4) - 20 mA, Ri = 200Ω
5	GND	I/O signal ground		
13	GND	I/O signal ground		
14	DI4	Digital input 4	Interlock 1	0 - +30 V Ri = 12 kΩ min
15	DI5	Digital input 5	Interlock 2	
16	DI6	Digital input 6	Interlock 3	
18	AO	Digital output Programmable in P5.3	Fault Inverted	0-10v, 0-20mA, Ri=500Ω
20	DO	Digital output Programmable in P5.2	Pump 3 Control	Discharge open, max. load 48 Vcc/50 mA
22	RO13	Relay output 1	Pump 1 Control	Max. switching load: 250Vac/2A or 250Vdc/0,4A
23	RO14			
24	RO22	Relay output Programmable in P5.1	Pump 2 Control	Max. switching load: 250Vac/2A or 250Vdc/0,4A
25	RO21			
26	RO24			

Table 6.10: PFC System preset I/O connections and settings for Vacon 10

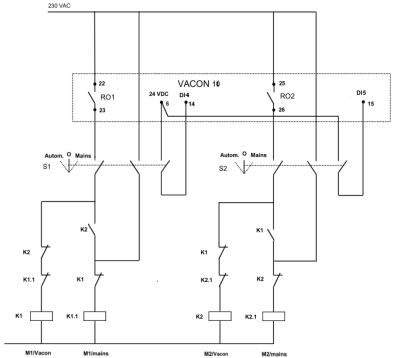


Figure 4: 2-pump autochange systems, sample control diagram

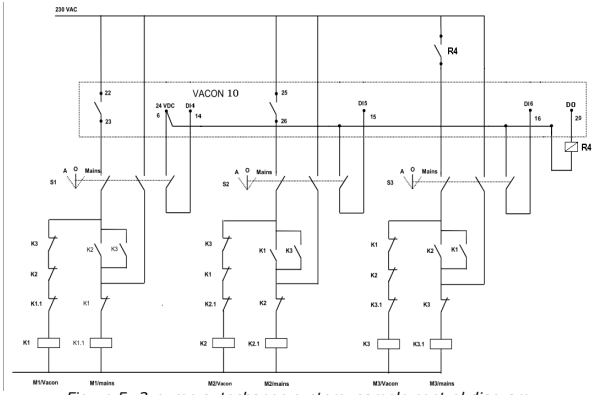


Figure 5: 3-pump autochange system, sample control diagram

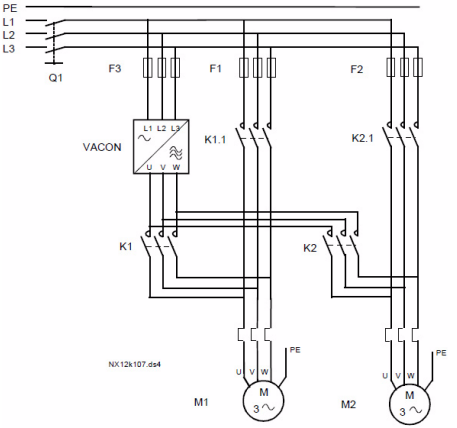


Figure 6: Example of 2-pump autochange, power diagram

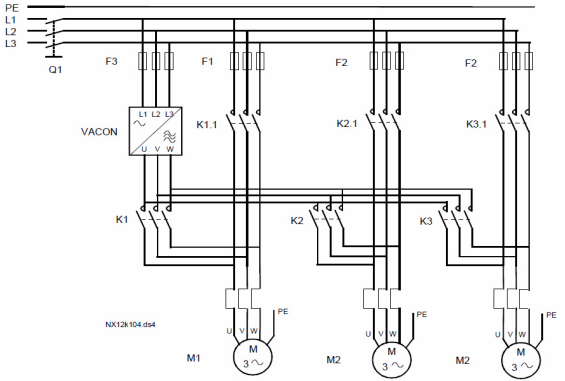


Figure 7: Example of 3-pump autochange, power diagram

7. CONTROL PANEL

7.1 General

The panel is integrated into the drive and consists of the corresponding E/S card and cover with an overlay that contains the display and buttons.

The Control panel consists of an LCD display with backlight and a keypad including a navigation wheel, a green system identification button and a red fault reset/start-up assistant button (see Figure 7.17.1).

7.2 Display

The display has 14 segments and 7 segment blocks, arrowheads and clear text symbols. The arrowheads (when visible) provide certain information about the drive. This information appears in the form of clear text on the overlay (numbers 1... 14 in the figure below). The arrowheads are divided into 3 groups with the following meanings and text on the overlay (see figure 7.1):

Group 1 - 5; Drive status

1 = Drive is ready to run (READY)
2 = Drive is running (RUN)
3 = Drive has stopped (STOP)
4 = Alarm is activated (ALARM)
5 = Drive has stopped due to a fault (FAULT)

Group 6 - 10; Control settings

6 = Motor is rotating forwards (FWD)
7 = Motor is rotating backwards (REV)
8 = E/S (I/O) Terminal block is selected control setting
de E/S (I/O)
9 = Keypad is selected control setting (KEYPAD)
10 = Fieldbus is selected control setting (BUS)

Group 11 - 14; Navigation menu

11 = Reference menu (REF)
12 = Monitoring menu (MON)
13 = Parameter menu (PAR)
14 = Fault history menu (FLT)

Figure 7.1: Vacon 10 control panel

7.3 Panel

The keypad section of the control panel consists of a navigation wheel and a fault reset/start-up assistant button and a system identification button (see Figure 7.1). The navigation wheel is used for navigating on the panel display, but also works as a reference potentiometer when DI3 has been enabled and P2.22 has been set to 0. The wheel has two different functions;

- rotating the wheel (for example, to change parameter values) (12 steps/rotation)
- pressing the wheel (for example, to accept the new value).

7.4 Navigating on the Vacon 10 control panel

This chapter provides information on navigating the menus on Vacon 10 and editing parameter values.

7.4.1 Main menu

The Vacon 10 control menu consists of a main menu and various submenus. Navigation in the main menu is shown below:

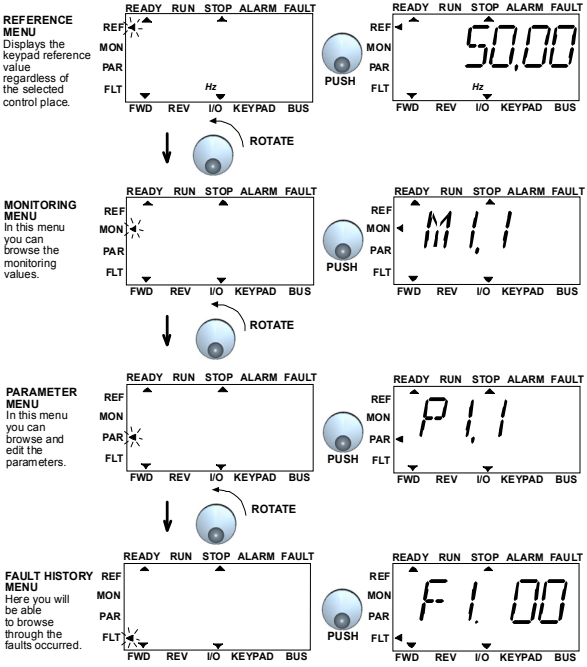


Figure 7.2: Vacon 10 main menu

7.4.2 Reference menu

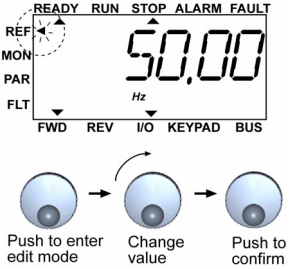


Figure 7.3: Reference menu display

Move to the reference menu using the navigation wheel (see Figure 7.2). The reference value can be changed using the navigation wheel as shown in Figure 7.3. The reference value follows the rotation continuously (= without accepting the new value).

7.4.3 Monitoring menu

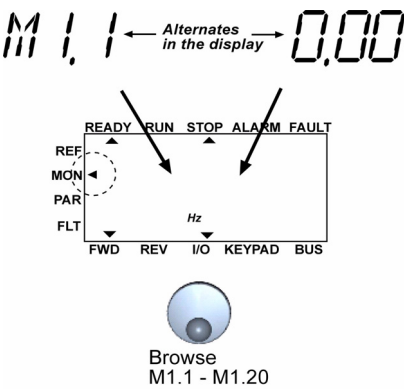


Figure 7.4: Monitoring menu display

Monitoring values are made up of the actual values of signals measured as well as the status of some control settings. They can be visualised on the display, but not changed. Monitoring values are listed in Table 7.13.

Pressing the navigation wheel once in this menu takes the user to the next level, where the monitoring value, e.g. M1.11 and the value are displayed (see Figure 7.2). Monitoring values can be examined by rotating the navigation wheel clockwise, as shown in Figure 7.4.

Code	Monitoring signal	Unit	ID	Description
M1.1	Output frequency	Hz	1	Frequency to the motor
M1.2	Frequency reference	Hz	25	
M1.3	Motor speed	rpm	2	Rated motor speed
M1.4	Motor current	A	3	Measured motor current
M1.5	Motor torque	%	4	Rated torque (nominal/real)
M1.6	Motor power	%	5	Calculated power (nominal/real)
M1.7	Motor voltage	V	6	Motor voltage
M1.8	DC-link voltage	V	7	Measured DC-link voltage
M1.9	Unit temperature	C°	8	Measured temperature
M1.10	Analog input 1	V	13	Value of AI1 in V
M1.11	Analog input 2	mA	14	Value of AI2 in mA
M1.12	DI1, DI2, DI3		15	Run / Ref PI2 / Undo PI
M1.13	DI4, DI5, DI6		16	Interlock 1 / Interlock 2 / Interlock 3
M1.14	RO1, RO2, DO		17	Output statuses
M1.15	Digital output (A0)		26	
M1.16	PI Reference	%	20	% of max. process reference
M1.17	Current pressure value	%	21	% of max. current value
M1.18	PI error	%	22	% of max. error value
M1.19	PI Output	%	23	% of max. output value
M1.20	Current pressure value	Kg	1616	Current pressure in Kg

Table 7.13: Monitoring values

7.4.4 Parameter menu

Parameter menu only shows the quick setup parameter list by default. By giving the right value to parameter 8.1, it is possible to access the other advanced parameter groups. Parameter lists and descriptions can be found in chapters 9 and 10.

The following figure shows the parameter menu display:

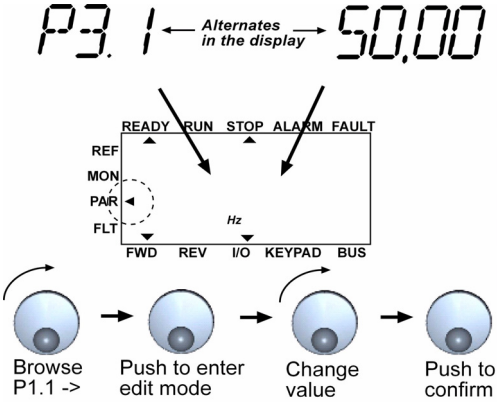


Figure 7.5: Parameter menu

7.4.5 Fault history menu

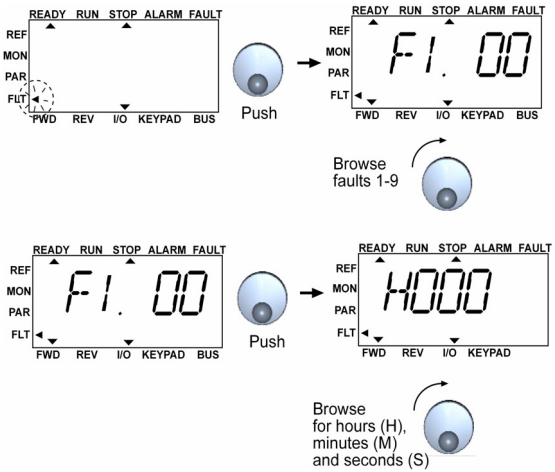


Figure 7.6: Fault history menu

You can browse through the last nine faults in the fault history menu (see Figure 7.6). If a fault is active, the corresponding fault reference (e.g. F1 02) alternates in the display with main menu. When you browse through the faults, the codes of active faults flash. Active faults can be reset by pressing the stop button for 1 second. If the fault cannot be reset, it will continue to flash. It is also possible to navigate through the menu when there are active faults, but the display returns automatically to the fault menu if no buttons or the navigation wheel are pressed or the navigation wheel is not rotated. The operating hour, minute and second when the fault occurs are shown in the value menu (operating hours = display reading x 1000 h).

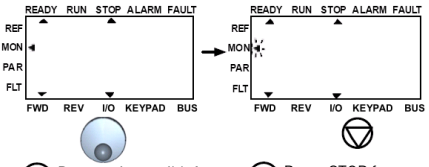
Note: The entire fault history can be deleted by pressing stop button for 5 seconds, when the drive has stopped and the fault history menu on the display has been selected.

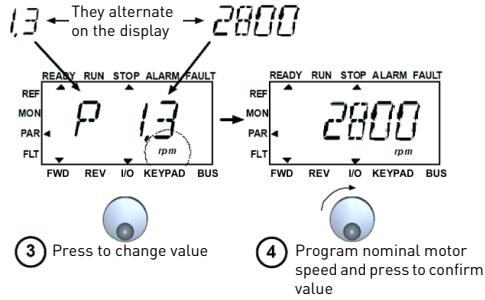
See Chapter 5 for fault descriptions.

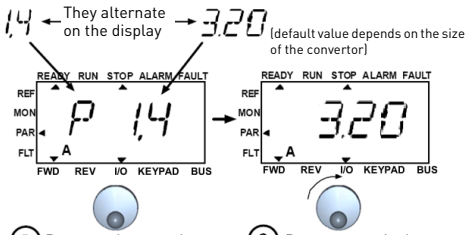
8. START-UP

8.1 Quick start-up wizard

Note: You should only use the wizard when starting up the controller, since parameters are reset to their factory default values every time it is used. If you need to change a particular value, you are recommended to go to the specific parameter (see page 11).

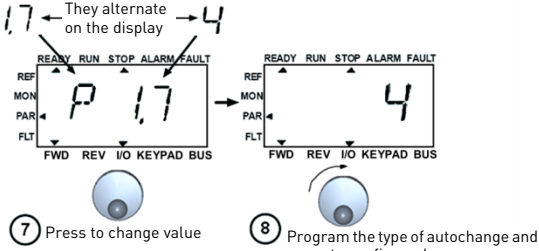






5 Press to change value

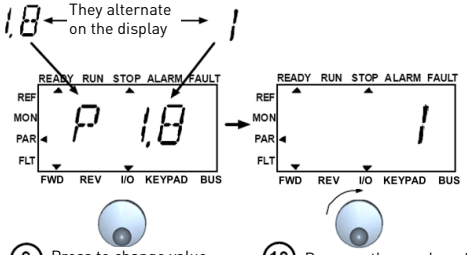
6 Program nominal motor current and press to confirm value



7 Press to change value

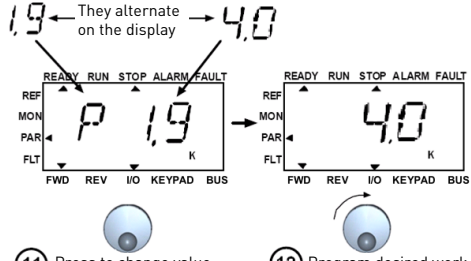
8 Program the type of autochange and press to confirm value

0.No autochange
1.Auxiliary autochange
2.Autochange of all
3.Auxiliary autochange with interlocks
4.Autochange of all with interlocks



9 Press to change value

10 Program the number of auxiliary pumps and press to confirm value



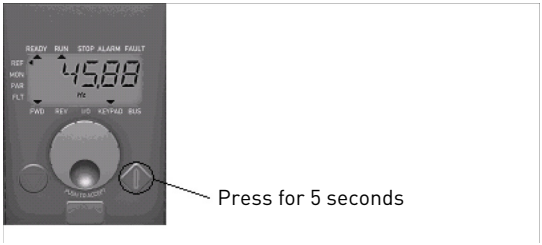
11 Press to change value

12 Program desired work pressure in Kg and press to confirm value

8.2 System identifcation function

In order to identify the pump, we must follow the steps listed below:

1. Completely close the pressure unit discharge to prevent water intake. Pressure must be 0 bars
2. Press the green (START) button for 5 seconds to start the pump and begin to carry out identification Identification takes around 60s. approximately).



3. Once the pump has stopped working, you can reopen the pressure unit intake and the equipment is ready to function.

9. SYSTEM PARAMETERS

On the next pages you will find the lists of parameters within their respective parameter groups. The parameter descriptions are given in Chapter 10.

NOTE: Some parameters can only be changed when the controller is in stop mode.

Explanations:

Code: Keypad Location. Shows the operator the monitoring value number of current parameter number.

Parameter: Parameter name or monitoring value

Min: Minimum value of parameter

Max: Maximum value of parameter

Unit: Unit of parameter value; given if available

Default: Factory preset value

ID: ID number of the parameter (used with fieldbus control)

More information on this parameter available in chapter 10: 'Parameter descriptions' and click on the name of the parameter.

9.1 Quick setup parameters

Code	Parameter	Min	Max	Unit	Default	ID	Note
P1.1	Nominal voltage of the motor	180	500	V	230 400	110	Check specification plate on the motor
P1.2	Nominal frequency of the motor	30	320	Hz	50,00	111	Check specification plate on the motor
P1.3	Nominal speed of the motor	300	20000	rpm	2800	112	Default applies for a 4-pole motor.
P1.4	Nominal current of the motor	0,2 x I_{Nunit}	1.5 x I_{Nunit}	A	I_{Nunit}	113	Check specification plate on the motor
P1.5	Motor cos φ	0,30	1,00		0,85	120	Check specification plate on the motor
P1.6	Min frequency	0	P3.1	Hz	30,00	101	Minimum frequency of pumps
P1.7	Autochange Mode	0	4		4	1603	0 = No Autochange 1 = Aux. autochange without interlocks 2 = Autochange all without interlocks 3 = Aux. autochange with interlocks 4 = Autochange all with interlocks
P1.8	Number of Auxiliary Pumps	0	3		1	1600	Auxiliary pumps in the system
P1.9	Desired work pressure	0	P2.20	Kg	4,0	167	Desired work pressure in Kg

Table 8.14: Quick setup parameters

9.2 Advanced PFC settings

Code	Parameter	Min	Max	Unit	Default	ID	Note
P2.1	Work pressure 2	P1.9	P2.20	Kg	5,0	1617	Second pressure reference. Activated using DI2
P2.2	**Acceleration**	**0,1**	**3000,0**	**S**	**3,0**	**103**	**Acceleration time from 0 Hz to maximum frequency**
P2.3	**Deceleration**	**0,1**	**3000,0**	**S**	**3,0**	**104**	**Deceleration time from maximum frequency to 0 Hz**
P2.4	PI Gain	0,0	1000,0	%	125,0	118	
P2.5	I Time, PI	0,00	320,00	s	1,00	119	
P2.6	PI Inversion Error	0	1		0	340	0 = Not inverted 1 = Inverted
P2.7	Autochange interval	0	3000,0	h	48,0	1604	0,0 = Test 40 s. Autochange time elapsed
P2.8	Autochange: Maxumum ^{No} of Auxiliaries	0	3		0	1605	Autochange level for auxiliary pump connection
P2.9	Autochange: Frequency limit	0,00	P3.1	Hz	0,00	1606	Controller output frequency level for autochange
P2.10	Auxiliary running frequency	P1.6	320,00	Hz	51,00	1607	
P2.11	Auxiliary connection delay	0,0	200,0	s	4,0	1601	
P2.12	Auxiliary stop frequency	P1.6	P3.1	Hz	31,00	1608	

Table 8.15: Advanced PFC settings

Code	Parameter	Min	Max	Unit	Default	ID	Note
P2.13	Auxiliary stop delay	0,0	200,0	s	2,0	1602	
P2.14	Snooze frequency	0,00	P3.1	Hz	31,0	1609	
P2.15	Snooze delay	0	3600	s	15	1610	
P2.16	Wake-up Level	0,00	100,0	%	92,00	1611	
P2.17	Wake-up Function	0	3		2	1612	0 = Wake-up below level (P2.16) 1 = Wake-up above level (P2.16) 2 = Wake-up below level (P1.9) 3 = Wake-up above level (P1.9)
P2.18	PI Hysteresis	0,0	50,0	%	2,0	1613	
P2.19	Increase Ref. PI to run	0,00	325,50	s	5,00	1614	
P2.20	Pressure Transducer Scale	0,0	100,0	Kg	10,0	1615	
P2.21	**Overpressure when snooze activated**	**0,0**	**10,0**	**Kg**	**0,0**	**1617**	
P2.22	**Frequency Selection (disable PI) (DI3)**	**0**	**1**		**1**	**1618**	**0 = Navigation wheel 1 = AI1**
P2.23	**Pressure Selection**	**0**	**1**		**0**	**1619**	**0 = Panel (P1.9) 1 = AI1**
P2.24	**Interlock updating**	**0**	**1**		**1**	**1619**	**0 = Always 1 = Only in Stop mode**

Table 8.15: Advanced PFC settings

9.3 Motor control

Code	Parameter	Min	Max	Unit	Default	ID	Note
P3.1	Maximum frequency	P1.6	320,00	Hz	50,00	102	
P3.2	Start mode	0	1		0	505	0 = Ramp 1 = Flying
P3.3	Stop mode	0	1		1	506	0 = Coasting 1 = Ramp
P3.4	Current threshold	0.2 x in	2 x in	A	1.5 x in	107	
P3.5	Motor control	0	1		0	600	0 = U/f 1 = Ctrl. Vector
P3.6	U/f ratio	0	1		1	108	0 = Linear 1 = Squared
P3.7	Field weakening points	30,00	320,00	Hz	50,00	602	
P3.8	Voltage at field weakening point	10,00	200,00	%	100,00	603	
P3.9	U/f optimization	0	1		0	109	0 = Not used 1 = Automatic torque boost
P3.10	Switching frequency	1,5	16,0	KHz	6,0	601	

Table 8.16: Motor control

9.4 Analog inputs

Code	Parameter	Min	Max	Unit	Default	ID	Note
P4.1	AI1 Hysteresis	0,000	9,000	v	0,100	1620	AI1 Sensitivity
P4.2	AI2 Signal Range	2	3		3	390	2 = 0 - 20mA 3 = 4 - 20mA
P4.3	AI2 filter time	0,0	10,0	s	0,1	389	0 = not filtered
P4.4	AI2 Customer Min.	-100,0	100,0	%	0,0	391	0.0 = Not scaled
P4.5	AI2 Customer Max.	-100,0	100,0	%	100,0	392	100.0 = Not scaled
P4.6	Minimum scaling Current Value	0,0	100,0	%	0,0	336	0 = Not scaled
P4.7	Maximum scaling Current Value	0,0	100,0	%	100,0	337	100.0 = Not scaled

Table 8.17: Analog inputs

9.5 Output signals

Code	Parameter	Min	Max	Unit	Default	ID	Note
P5.1	Relay 2 (RO2)	0	3		0	314	0 = Ctrl. Pump 2 1 = Ready 2 = Run 3 = Fault
P5.2	Digital Output (DO)	0	3		0	315	0 = Ctrl. Pump 3 1 = Ready 2 = Run 3 = Fault
P5.3	Digital Output (AO)	0	3		0	315	0 = Ready 1 = Run 2 = Fault 3 = Fault inverted

Table 8.18: Output signals

9.6 Protection

Code	Parameter	Min	Max	Unit	Default	ID	Note
P6.1	Response to fault 4mA	0	2		2	700	0 = No response 1 = Warning 2 = Fault, stop as in P3.3
P6.2	Response undervoltage fault	0	2		2	727	
P6.3	Ground fault protection	0	2		2	703	
P6.4	Low frequency protection	0,00	99,99	s	10,00	1621	
P6.5	Underload protection	0	2		2	713	As in P6.1
P6.6	Torque curve at zero frequency	0	150,0	%	10,0	715	
P6.7	Torque curve a nominal frequency	0	150,0	%	50,0	714	
P6.8	Underload protection time limit	2,00	320,00	s	20,0	716	
P6.9	Motor thermal protection	0	2		0	704	As in P6.1
P6.10	Motor ambient temperature	-20	100	C	40	705	
P6.11	Motor cooling factor a zero speed	0.0	150,00	%	40,0	706	
P6.12	Motor thermal time constant	1	200	min	45	707	
P6.13	Motor stall current	0.2 x INunit	1.5 x INunit	A	0	1622	Current threshold for block fault activation

Table 8.19: Protection

9.7 Automatic restarts

Code	Parameter	Min	Max	Unit	Default	ID	Note
P7.1	Wait time	0,10	10,00	s	0.50	717	Delay before automatic restart after a fault disappears
P7.2	Trial time	0,00	320,00	s	90.00	718	Defines the time before the frequency converter attempts to automatically restart the motor after a fault has disappeared
P7.3	Start mode	0	2		0	719	0 = Ramp 1 = Flying start 2 = As in P3.2
P7.4	Automatic restart code	0	32500		0	731	0 = Disabled

Table 8.20: Automatic restarts

9.8 Hide parameters

Code	Parameter	Min	Max	Unit	Default	ID	Selections
P8.1	Hide parameters	0	1		1	115	0 = Parameters visible 1 = Parameters hidden

Table 8.21: Hide parameters

9.9 System parameters

Code	Parameter	Min	Max	Default	ID	Note
Software information (MENU PAR -> S1)						
S1.1	Software package				833	
S1.2	Power SW version				834	
S1.3	API SW version				835	
S1.4	API Firmware interface				836	
S1.5	Application ID				837	
S1.6	Application revision				838	
S1.7	System load				839	
RS485 information (MENU PAR -> S2)						
S2.1	Communication status				808	Format: **xx.yyy xx** = 0 - 64 (Number of error messages) **yyy** = 0 - 999 (Number of correct messages)
S2.2	Fieldbus protocol	0	1	0	809	**0 =** FB disabled **1** = Modbus
S2.3	Slave address	1	255	1	810	
S2.4	Baud rate	0	5	5	811	**0**=300, **1**=600, **2**=1200, **3**=2400, **4**=4800, **5**=9600,
S2.5	Number of stop bits	0	1	1	812	**0**=1, **1**=2
S2.6	Parity type	0	0	0	813	**0**= None (locked)
S2.7	Communication time-out	0	255	10	814	**0** = Not used, **1** = 1 second, **2** = 2 seconds, etc.
S2.8	Reset communication status				815	**1** = Reset torque S2.1
Total counters (MENU PAR -> S3)						

Table 8.22: System parameters

Code	Parameter	Min	Max	Default	ID	Note
S3.1	MWh counter				827	
S3.2	Power on days				828	
S3.3	Power on hours				829	
User settings (MENU PAR -> S4)						
S4.1	Display contrast	0	15	7	830	Adjust display contrast
S4.2	Restore factory defaults	0	1	0	831	**1**= Restores factory defaults for all parameters

Table 8.22: System parameters

NOTE: Parameters in bold are hidden, see P8.1.

10. PARAMETER DESCRIPTIONS

The following pages list the descriptions of certain parameters. Descriptions have been arranged according to parameter group and number.

GROUP 1. Quick setup parameters

1.7 AUTOCHANGE MODE

This parameter allows the user to select the autochange mode for the system.

Autochange is used to make pump wear more uniform.

0 = No autochange. Connection/disconnection order of pumps will always remain the same and the controller will regulate the speed of the first pump.

1 = Auxiliary autochange without interlocks. Controller regulates the speed of the first pump and auxiliary pumps alternate (connecting and disconnecting).

2 = Total autochange without interlocks. Controller alternates the regulation of all pump speeds in the system.

3 = Auxilliary autochange with interlocks. Controller regulates the speed of the first pump and auxiliary pumps alternate (connecting and disconnecting). Interlocks are required to connect pumps.

5 = Total autochange with interlocks. Controller alternates regulation of the speed of all the pumps in the system. Interlocks are required to connect pumps.

1.8 NUMBER OF AUXILIARY PUMPS

Auxiliary pumps assist the main pump.
For example, a pressure unit with a total of 3 pumps has 2 auxiliary pumps.
Number of Auxiliary Pumps = Nº of pumps - 1.

GROUP 2. Advanced PFC settings

2.1 WORK PRESSURE 2
By enabling digital input DI2, you can work with the pressure inserted in this parameter.

2.2 ACCELERATION
Acceleration time from 0Hz to maximum frequency.

2.3 DECELERATION
Deceleration time from maximum frequency to 0Hz.

2.4 PI CONTROLLER GAIN
This parameter defines the gain of the PI controller. If this parameter is set to 100%, a 10% change in the error value results in a 10% change in controller output.

2.5 PI CONTROLLER I-TIME
This parameter defines the integration time of the PI controller. If this parameter is set to 1.00 second, controller output changes by a value corresponding to the output caused by the gain every second. (Gain/Error)/s.

2.6 PID ERROR VALUE INVERSION
This parameter enables users to invert the PID controller error value (and therefore PID controller operations).

0 Not inverted
1 Inverted

2.7 AUTOCHANGE INTERVAL
After the time set by this parameter has elapsed, autochange takes place if the load used is less than the level set in parameters P2.9 (autochange interval limit) and 2.8 (Maximum number of auxiliary pumps). If the load exceeds the value in parameter 2.9, autochange will not occur until the load is below this limit.

- Timing is enabled only if Start/Stop request is activated.
- Timing is reset after autochange takes place or when the Start request is removed.

2.8 MAXIMUM NUMBER OF AUXILIARY START-UPS AND

2.9 AUTOCHANGE: INTERVAL LIMIT

These parameters set the maximum load for autochange to take place.

This level is defined as follows:

- Autochange can take place if the number of auxiliary pumps running is lower than the value in parameter 2.89, autochange may take place.
- Autochange can take place if the number of auxiliary pumps running is equivalent to the value in parameter 2.8 and controlled drive frequency is lower than the value in parameter 2.9.
- If the value in parameter 2.9 is 0.0 Hz, autochange can only take place when on standby (Stop and Snooze) regardless of the value in parameter 2.8.

2.10 AUXILIARY PUMP START FREQUENCY

When the pump controlled at this output frequency, or higher, and the time set in P2.11 has elapsed, an auxiliary pump will be connected.

2.11 AUXILIARY PUMP START DELAY

The time that must elapse before an auxiliary pump is connected when the main pump is at its maximum level of output, if required by the system.

2.12 AUXILIARY PUMP FREQUENCY

When the controlled pump runs at this output frequency, or a lower value, and the time set in P2.13 has elapsed, an auxiliary pump will be disconnected.

2.13 AUXILIARY PUMP STOP DELAY

Time that must elapse before an auxiliary pump is disconnected, when the controlled pump is at its minimum level of output.

2.14 SNOOZE FREQUENCY

Frequency converter cuts out automatically if running frequency drops below the snooze level, set by this parameter, for a longer period of time than established in parameter 2.15. While Stopped, the PI controller changes the frequency converter to Start mode when the current value drops below or exceeds (see parameter 2.17) the wake-up Level set in parameter 2.16.

2.15 SNOOZE DELAY

The minimum amount of time that frequency should remain below the snooze Level before the frequency converter cuts out.

2.16 WAKE-UP LEVEL
The wake-up level defines the level that the current value must drop below or exceed before the Start mode of the frequency converter is restored.

2.17 WAKE-UP FUNCTION
This parameter defines whether Start mode is restored when the signal of the current value drops below or exceeds wake-up Level (parameter 2.16).

2.18 PI HYSTERESIS
In installations where the level of noise produced by the transducer may not allow the system to ever go into snooze mode, this parameter can help offset this effect.

2.19 REFERENCE INCREASE START PI
Delay time before the pressure reference reaches 100%.

2.20 PRESSURE TRANSDUCER SCALE
Maximum pressure permitted by pressure transducer.

2.21 OVERPRESSURE IN SNOOZE MODE
Overpressure that takes place in the installation when the system goes into snooze mode.

2.22 REFERENCE FREQUENCY SELECTION (PI DISABLED) (DI3)
Parameter that allows the user to select the source of the reference frequency, when PI has been disabled using DI3.
0 = Panel
1 = AI1

2.23 REFERENCE PRESSURE SELECTION
Parameter that allows the user to select the source of work pressure.
0 = Panel (P1.9/P2.1)
1 = AI1

GROUP 3. Motor Control

3.2 START MODE

The user can select two start modes for Vacon 10 with this parameter:

0 = Ramp start
The frequency converter starts from 0 Hz and accelerates to the set frequency reference within the set acceleration time (P4.2). (Load inertia or initial friction may lengthen acceleration times).

1 = Flying start:
The frequency converter is also able to start running a motor by applying a small torque to it and searching for the frequency that matches the speed the motor is running at. Searching starts at maximum frequency and works downwards until the correct frequency is detected. Therefore, output frequency will be increased/decreased to the set reference value according to the set acceleration/deceleration parameters. Use this mode if the motor is rotating when the start command is given. A flying start makes it possible to ride through short interruptions in mains voltage

3.3 STOP MODE

Two stop modes can be selected in this application.

0 = Coasting:
The motor coasts to a halt without control from the frequency converter after the Stop command.

1 = Ramp stop:
After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters.
If regenerated energy is high, it may be necessary to use an external braking resistor to decelerate the motor in acceptable time.

3.5 MOTOR CONTROL

With this parameter the user can select the motor control mode. The options are:

0 = Frequency Control:
I/O terminal references are frequency references and the frequency converter controls output frequency (output frequency resolution = 0.01 Hz)

1 = Speed Control:
I/O terminal references are speed references and the frequency converter controls motor speed.

3.6 U/F RATIO

The options for this parameter are:

0 = Linear:
Motor voltage changes linearly with the frequency in the constant flux area from 0 Hz to the field weakening point where nominal voltage is supplied to the motor.
Linear U/f ratio should be used in constant torque applications. See Figure 9.17.
This default setting should be used if no other adjustment is necessary.

1 = Squared:
Motor voltage changes following a squared curve form with the frequency in the area from 0 Hz to the field weakening point where nominal voltage is also supplied to the motor. The motor runs magnetised below the field weakening point and produces less torque, power losses and electromechanical noise. The U/f ratio can be used in applications in which load torque is proportional to squared speed.

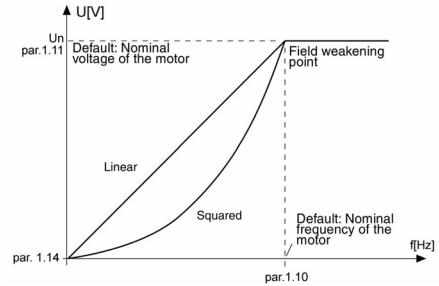


Figure 10.1: Linear and motor voltage change

2 = Programmable U/f curve:

The U/f curve can be programmed with three different points. Programmable U/f curve can be used if the other settings do not satisfy the needs of the application

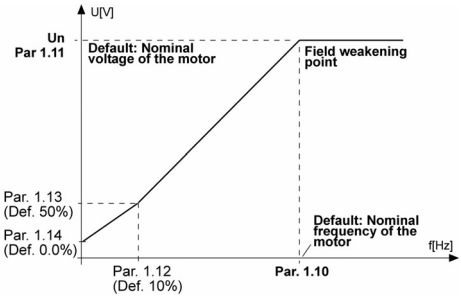


Figure 10.2: Programmable U/f curve

3.7 FIELD WEAKENING POINT

The field weakening point is the output frequency at which the output voltage reaches the value set with parameter 3.8.

3.8 VOLTAGE AT FIELD WEAKENING POINT

The field weakening point is the output frequency at which the output voltage reaches the value set with parameter 3.8.

3.8 Voltage at field weakening point
Above the frequency at the field weakening point, the output voltage remains at the value set with this parameter. Below the frequency at field weakening point, the output voltage depends on the setting of the U/f curve parameters.

When parameters 1.1 and 1.2 (nominal voltage and nominal frequency of the motor) are set, parameters 3.7 and 3.8 are given the corresponding values automatically. If you need different values for the field weakening point and voltage, change these parameters after setting parameters 1.1 and 1.2.

3.9 U/F OPTIMIZATION

0 Not used

1 Automatic Torque Boost

The voltage to the motor changes automatically which makes the motor produce sufficient torque to start and run at low frequencies. The increase in voltage depends on motor type and power. Automatic torque boost can be used in applications with high start torque due to friction, e.g. in conveyor belts.

3.10 SWITCHING FREQUENCY

Motor noise can be minimised using a high switching frequency. Increasing the switching frequency reduces the capacity of the frequency converter unit.

Switching frequency for Vacon 10: 1.5...16 Hz.

GROUP 4. Analog Inputs

4.1 AI1 HYSTERESIS
Analog Input Sensitivity

4.2 AI2 SIGNAL RANGE
2 = 0 - 20 mA
3 = 4 - 20 mA

4.3 AI2 FILTER TIME
This parameter, given a value greater than 0, activates the function that filters out disturbances from the incoming analog signal.

4.4 CUSTOMER MIN.

4.5 CUSTOMER MAX.
These parameters make it possible to scale input current from 0 to 20 mA.

4.6 MINIMUM SCALING

4.7 MAXIMUM SCALING
Set maximum/minimum scaling to current Value.

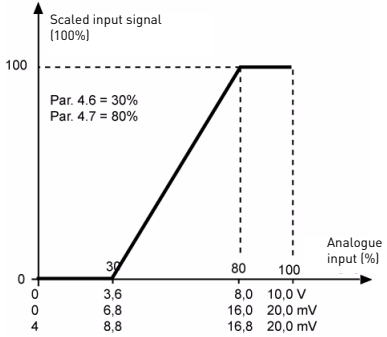


Figure 10.3: Example of signal scaling

GROUP 5. Output Signals

5.1 RELAY 2 (RO2)

0 = Pump 2 Control
1 = Ready
2 = Run
3 = Fault

5.2 DIGITAL OUTPUT (DO)

0 = Pump 3 Control
1 = Ready
2 = Run
3 = Fault

5.3 DIGITAL OUTPUT (AO)

0 = Ready
1 = Run
2 = Fault
3 = Fault Inverted

GROUP 6. Protection

6.5 UNDERLOAD PROTECTION

0 = No response
1 = Warning
2 = Fault, stop mode after fault as in parameter 3.3

Pump is underloaded. Check: that pump suction is not obstructed or blocked, that the pump has enough water.

If the pumping is working properly, you should set parameters P6.6 and P6.7.

Underload protection, field weakening area load
Torque limit can be set between 0.0-150.0 % x TnMotor.
This parameter provides the minimum torque value permitted when output frequency is above the field weakening point. See Figure 1-22.

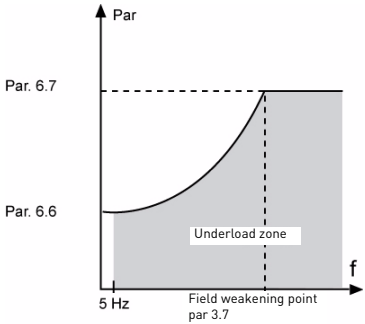


Figure 10.4: Setting Minimum Load

6.6 TORQUE CURVE AT ZERO FREQUENCY

Torque limit can be set between 0.0-150.0 % x TnMotor. This paramter provides the minimum torque value permitted at zero frequency. See Figure 1-22.

If the value of parameter 1.4 is changed (nominal motor current), this parameter automatically resets to the default value.

6.8 UNDERLOAD PROTECTION TIME LIMIT

This time can be set between 2.0 and 320.00 s.
This is the maximum amount of time permitted in underload status. An internal timer measures the time accumulated in underload status. If the underload timer exceeds this limit, the protection will cause a fault as in parameter 6.5. If the pump stops, the underload timer resets to zero. See Figure 1-23.

.

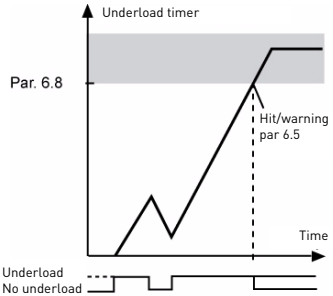


Figure 10.5: Underload Timer Function

MOTOR THERMAL PROTECTION (PARAMETERS 6.9 - 6.11)

Motor thermal protection is to protect the motor from overheating. The Vacon drive is capable of supplying higher than nominal current to the motor. If the load requires this high current there is a risk that the motor will thermally overheat. This is particularly the case at low frequencies. At low frequencies the cooling effect of the motor is reduced as well as its capacity. If the motor is equipped with an external fan the load reduction at low speeds is small. Motor thermal protection is based on a calibrated model and uses the output current of the drive to determine the load on the motor.
Motor thermal protection can be adjusted with parameters. The thermal current IT specifies the load current above which the motor will be overloaded. This current threshold is a function of the output frequency.

CAUTION! The calibrated model does not protect the motor if the air intake grill is blocked and reduces the airflow to the motor.

6.9 THERMAL PROTECTION OF THE MOTOR

0 = No response
1 = Warning
2 = Fault, stop mode after an error as in parameter 3.3

If tripping is selected, the drive will stop and activate the fault phase. Al Disable protection (that is, by setting the parameter to 0), the thermal model of the motor is reset to 0%.

6.10 MOTOR AMBIENT TEMPERATURE

When motor ambient temperature should be taken into account, the user should change this parameter. Values can range
from -20 to 100 degrees Celsius.

6.11 MOTOR COOLING FACTOR AT ZERO SPEED

Cooling power can be set between 0-150.0% x cooling power at nominal frequency. See Figure 10.6.

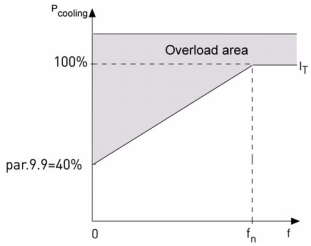


Figure 10.6: Motor cooling power

9.12 MOTOR THERMAL TIME CONSTANT

This time can be set between 1 and 200 minutes.

This is the thermal time constant of the motor. The larger the motor, the longer the time constant. The time constant is the time within which the calibrated thermal model has reached 63% of its final value.

Motor thermal time is specific to motor design and varies from one motor manufacturer to another.

If the motor t6-time (t6 is the time in seconds the motor can safely operate at six times the rated current) is known (given by the motor manufacturer), it can be used as a basis for setting the time constant parameter. As a rule of thumb, the motor thermal time constant in minutes is equal to 2xt6. If the drive is in stop mode, the time constant is internally increased to three times the set parameter value. See also Figure 10.7.

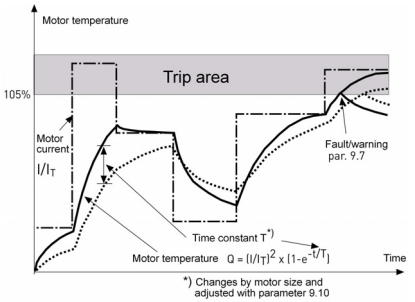


Figure 10.7: Motor temperature calculation

GROUP 7. Automatic Restarts

7.2 AUTOMATIC RESTART, TRIAL TIME

The automatic restart function restarts the frequency converter when the faults have disappeared and waiting time has elapsed.

The time count starts from the first autorestart. If more than three faults occur during trial time, the fault mode is activated. Otherwise, the fault is cleared after the trial time has elapsed and the next fault starts the trial time count again. See Figure 10.8.

If one single fault remains during the trial time, fault mode is true.

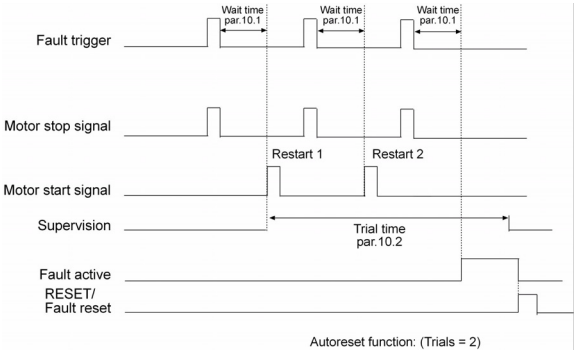


Figure 10.8: Automatic restart

7.4 AUTOMATIC RESTART, TRIAL TIME

A binary code is inserted in this parameter to enable or disable automatic restarts for some faults.

Example:
Bit 0 = Undervoltage
Bit 1 = Overvoltage
Bit 2 = Overcurrent
Bit 3 = Motor Overheating
Bit 4 = Underload
Bit 5 = User Error

Examples:

1. If we only want to restart the controller when Undervoltage and Overvoltage faults appear, we should set P7.4 to 3.
2. If we only want to restart the controller when Undervoltage and Overcurrent faults appear, we should set P7.4 to 5.
3. If we only want to restart the controller when Overcurrent faults apper, we should set P7.4 to 4.

11. TECHNICAL DATA

11.1 Vacon 10 technical data

Mains connection	Input voltage U_{in}	380 - 480V, -15%...+10% 3~ 208...240V, -15%...+10% 1~
	Input frequency	45...66 Hz
	THD Line current	> 120%
	Connection to mains	Once per minute or less (normal case)
Supply network	Networks	Vacon 10 (400 V) cannot be used with networks that have a phase to ground
	Short circuit current	The maximum short circuit current must be lower than 50 kA
Connecting the motor	Output voltage	0 - U_{in}
	Output current	I_N estimated direct current at max. room temperature. +50°C, overload 1.5 x I_N max. 1 min/ 10 min.
	Starting current / torque	2 x I_N current for 2 s every 20 s Torque depends on the motor.
	Output frequency	0...320 Hz
	Frequency resolution	0.01 Hz
Control characteristics	Control method	U/f Frequency control Open Loop Sensorless Vector Control
	Switching frequency	1...16 kHz; Factory default 6 kHz
	Frequency reference	Resolution 0.01 Hz
	Field weakening point	30...320 Hz
	Acceleration time	0.1...3000 s
	Deceleration time	0.1...3000 s
	Braking torque	100%*T_N with brake option (only for 400 V $\geq$ 1.5 kW) 30%*T_N without brake option

Table 11.1: Vacon 10 technical data

Ambient conditions	Operating ambient temperature	-10°C (no frost)...+50°C: Estimated load capacity I_N
	Storage temperature	-40°C...+70°C
	Relative humidity	0...95% RH, with no condensation, rust or dripping water.
	Air quality: - chemical vapours - mechanical particles	 IEC 721-3-3, unit in operation, class 3C2 IEC 721-3-3, unit in operation, class 3S2
	Altitude	100% load capacity (without reduction) of up to 1000 m. 1% reduction per 100 m above 1000 m; max. 2000 m.
	Vibration: EN60068-2-6	3...150 Hz Shift range 1(spike) mm at 3...15.8 Hz Max. range of acceleration 1 G at 15.8...150 Hz
	Knocks IEC 68-2-27	UPS drop test (for applicable UPS weights) Storage and shipping: Max of 15 G, 11 ms (with packaging)
	Type of enclosure	IP20
EMC	Immunity	Complies with EN50082-1, -2, EN61800-3
	Emissions	230 V: Complies with EMC category C2 (level H Vacon); With an internal RFI filter 400V: Complies with EMC category C2 (level H Vacon): With an internal RFI filter Both: Without protection against EMC emissions (level N Vacon): Without RFI filter
Standards		For EMC: EN61800-3, For safety: UL508C, EN61800-5
Certificates and manufacturer declarations of conformity		For safety: CB, CE, UL, cUL, For EMC: CE, CB, c-tick (see drive nameplate for more detailed information)

Table 11.1: Vacon 10 technical data

11.2 Power ratings

11.2.1 Vacon 10 - Mains voltage 115 V

Mains voltage 115 V, 50/60 Hz, 1~ series					
Frequency converter type	Rated loadability		Motor shaft power	Nominal input current	Mechanical size and weight (kg)
	100% direct current I_N [A]	150% overload current [A]	P [kW]	[A]	
0001	1,7	2,6	0,25	9,2	MI2
0002	2,4	3,6	0,37	11,6	MI2
0003	2,8	4,2	0,55	12,4	MI2
0004	3,7	5,6	0,75	15	MI2
0005	4,8	7,2	1,1	16,5	MI3

Table 11.2: : Vacon 10 rated loadability, 115 V

11.2.2 Vacon 10 - Mains voltage 208 - 240 V

Mains voltage 208-240 V, 50/60 Hz, 1~ series					
Frequency converter type	Rated loadability		Motor shaft power	Nominal input current	Mechanical size and weight (kg)
	100% direct current I_N [A]	150% overload current [A]	P [kW]	[A]	
0001	1,7	2,6	0,25	4,2	MI1 0.55
0002	2,4	3,6	0,37	5,7	MI1 0.55
0003	2,8	4,2	0,55	6,6	MI1 0.55
0004	3,7	5,6	0,75	8,3	MI2 0.70
0005	4,8	7,2	1,1	11,2	MI2 0.70
0007	7,0	10,5	1,5	14,1	MI2 0.70
0009*	9,6	14,4	2,2	15,8	MI3, 0.99

Table 11.3: Vacon 10 power ratings, 208 - 240 V

Maximum Vacon 10 operating ambient temperature

Mains voltage 208-240 V, 50/60 Hz, 3~ series					
Frequency converter type	Rated loadability		Motor shaft power	Nominal input current	Mechanical size and weight (kg)
	100% direct current I_N [A]	150% overload current [A]	P [kW]	[A]	
0001	1,7	2,6	0,25	2,7	MI1
0002	2,4	3,6	0,37	3,5	MI1
0003	2,8	4,2	0,55	3,8	MI1
0004	3,7	5,6	0,75	4,3	MI2
0005	4,8	7,2	1,1	6,8	MI2
0007	7,0	10,5	1,5	8,4	MI2
0011	11	16,5	2,2	13,4	MI3

Table 11.4: Vacon 10 power ratings, 208 - 240 V, 3~

11.2.3 Vacon 10 - Mains voltage 380 - 480 V

Mains voltage 380-480 V, 50/60 Hz, 3~ series					
Frequency converter type	Rated loadability		Motor shaft power	Nominal input current	Mechanical size and weight (kg)
	100% direct current I_N [A]	150% overload current [A]	Supply of 380 - 480 V P[kW]	[A]	
0001	1,3	2,0	0,37	2,2	MI1 0.55
0002	1,9	2,9	0,55	2,8	MI1 0.55
0003	2,4	3,6	0,75	3,2	MI1 0.55
0004	3,3	5,0	1,1	4,0	MI2 0.70
0005	4,3	6,5	1,5	5,6	MI2 0.70
0006	5,6	8,4	2,2	7,3	MI2 0.70
0008	7,6	11,4	3,0	9,6	MI3, 0.99
0009	9,0	13,5	4,0	11,5	MI3, 0.99
0012	12,0	18,0	5,5	14,9	MI3, 0.99

Table 11.5: Vacon 10 power ratings, 380 - 480 V

Note 1: The input currents are values calculated with a 100 kVA line transformer supply.

Note 2: The mechanical dimensions of the drives are given in Chapter 3.1.1.

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